

NanoGenizer: High-Pressure Homogenizer for Nanomaterials

NanoGenizer is a state-of-the-art, lab-scale microfluidic [high-pressure homogenizer](#) that excels in particle size reduction and cell disruption. It leverages high-pressure microfluidic jet technology and is equipped with highly modular power and processing units. Designed with a minimum dead volume and a continuous flow rate of up to 120 mL/min, NanoGenizer is particularly well-suited for processing rare and valuable samples. Its exceptional performance, characterized by notable shear rate, excellent repeatability, and guaranteed scalability, has led to its growing recognition and adoption across various nanotechnology settings.

NanoGenizer offers efficient solutions for a wide range of nanomaterials, including liposomes, nano-emulsions, nano-crystals, micelles, lipid nanoparticles, cosmetic nano-encapsulation materials, nano-particle dispersion, graphene, carbon nanotubes, and more. Its versatility and effectiveness have made it an essential high-pressure homogenizer for laboratories engaged in high-end nanomaterial preparation. As more organizations become aware of its capabilities, NanoGenizer continues to establish itself as a leading choice in this field.



Core Technology: [Microfluidic Jet Interaction Chamber](#)

The NanoGenizer comprises a power unit, which includes the power system, control system, and high-pressure pump system, and a processing unit, which includes the microfluidic diamond interaction chamber, material inlet and outlet, and heat exchanger. The diamond interaction chamber serves as a critical component for reactions, featuring a specially designed fixed geometry. It facilitates the occurrence of high-pressure, high-speed micro-jets for sample processing.

Through pressurization and acceleration by the intensifier, the sample's micro-jet can attain speeds exceeding 1,000 m/s, surpassing the speed of sound (340 m/s). As the high-speed bullet-like micro-jet passes through the micro-channels of the diamond interaction chamber, it undergoes various complex physical phenomena, including high-frequency shearing, high-energy impact, cavitation, pressure drop, and more. Consequently, the material undergoes homogenization and achieves a nano-sized state.

The diamond interaction chamber acts as the core region where the high-speed micro-jet and other effects, such as high-shear and high-energy collisions, take place. It incorporates fixed Y- or Z-shaped diamond micro-channels to ensure consistent and repeatable particle size distribution with utmost accuracy.

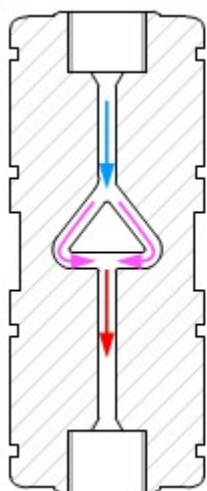


Figure 2. Schematic of the internal structure of the DIXC

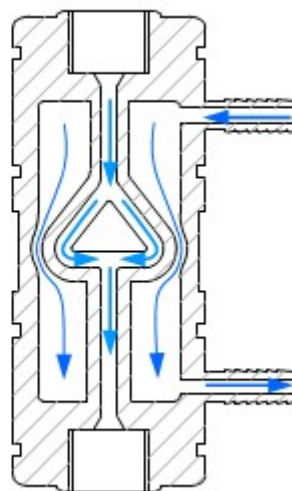


Figure 3. Single-slotted interaction chamber with cooling system

Features of the NanoGenizer High-Pressure Homogenizer:

High Shear Rate

Upon pressurization by the power unit, the micro-jet of the liquid or solid-liquid mixture sample can reach speeds up to 1,000 m/s inside the Diamond Interaction Chamber (DIXC). The minimum dimension of the DIXC's interior can be as small as 50 μm . Figure 4 illustrates that the NanoGenizer exhibits the highest shear rate among comparable technologies.

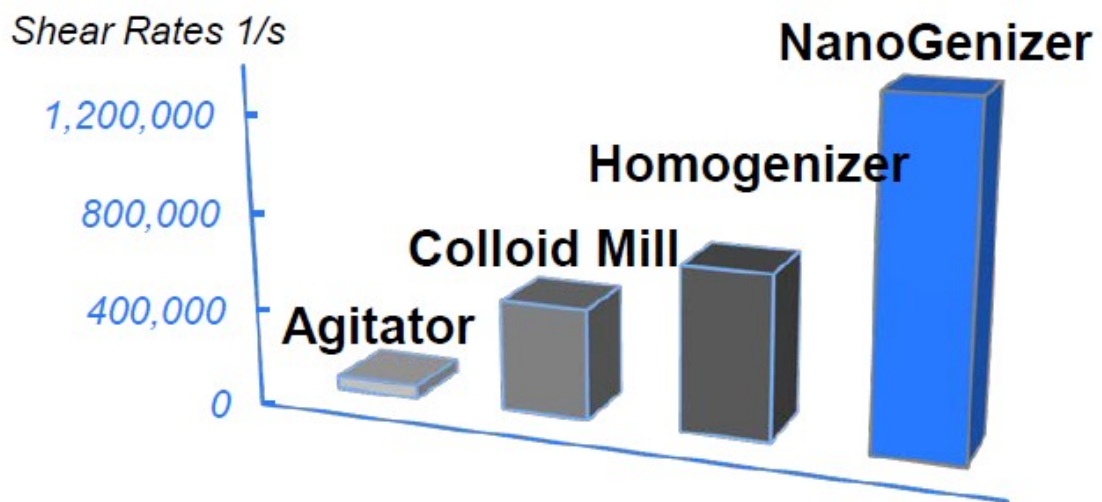


Figure 4. Shear rates of comparable homogenizing technologies

The NanoGenizer high-pressure homogenizer offers an unparalleled shearing force on materials, surpassing that of conventional homogenizers and other homogenizing equipment..

Fixed Internal Structure and Consistent Reaction Pressure

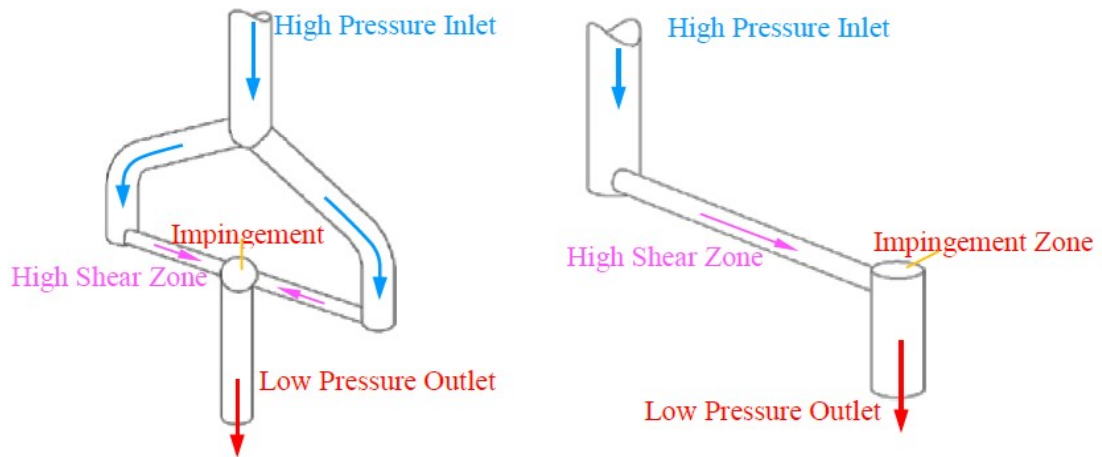


Figure 5. Single-slotted Y-type microfluidic diamond interaction chamber

Figure 6. Single-slotted Z-type microfluidic diamond interaction chamber

The diamond interaction chamber has a fixed internal shape (Figures 5 and 6) and remains stationary despite changes in pressure. When the sample flows through the DIXC, the applied pressure reaches a constant peak in each cycle (refer to the blue curve in Figure 7). In contrast, the traditional homogenizing valve possesses a dynamically adjustable structure. As the material passes through a conventional homogenizer's valve, the pressure undergoes dynamic changes, with peak pressures occurring only for brief moments in each cycle (indicated by the black curve in Figure 7). The microfluidic diamond interaction chamber efficiently reduces the particle size of the processed material and achieves a more uniform distribution compared to a traditional homogenizing valve.

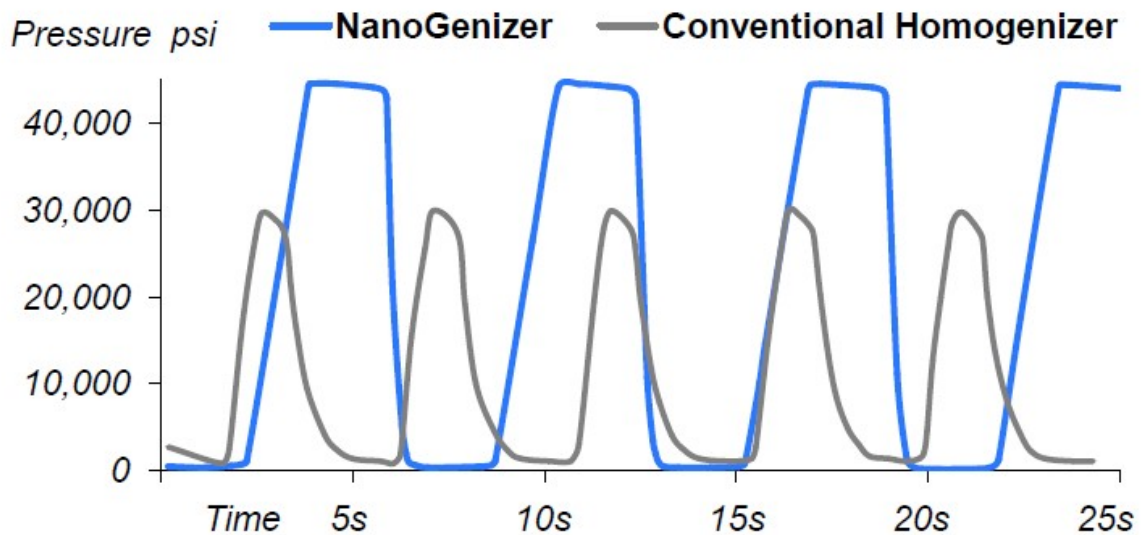


Figure 7. Pressure curve during homogenization process

Interaction Effect

The design of the Y-type DIXC optimally utilizes the interaction collision between the materials. This design effectively doubles the instantaneous relative velocity of the two jets, leading to a pronounced explosive effect. The collision between the materials effectively minimizes wear and shear on the interaction chamber, thereby extending the chamber's service life and minimizing the risk of stainless steel particle detachment. The patented DIXC-RT with a cooling function (refer to Figure 3) also preserves the bioactivity of the samples.

Guaranteed Scalability

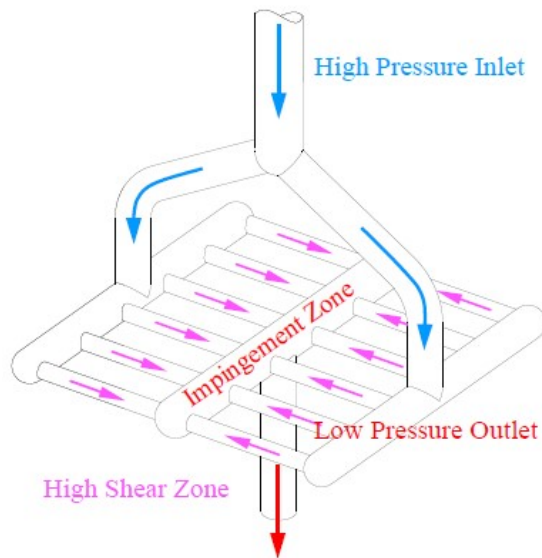


Figure 8. Multi-slotted Y-type microfluidic diamond interaction chamber

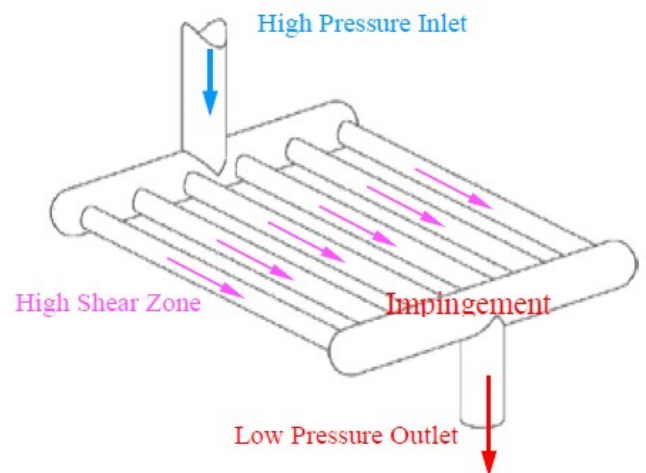


Figure 9. Multi-slotted Z-type microfluidic diamond interaction chamber

The single-slotted DIXC (shown in Figures 2 and 3) is suitable for laboratory-scale high-pressure homogenization equipment. On the other hand, the multi-slotted DIXC (depicted in Figures 8 and 9) consists of multiple diamond micro-channels arranged in parallel, ensuring consistent treatment effects. The increased number of channels also allows for a higher volumetric flow rate.

[Genizer LLC](#) is one of two companies worldwide that supply high-pressure homogenizers equipped with original microfluidic diamond interaction chambers. In recent years, more and more homogenizer manufacturers have adopted Genizer's microfluidic diamond interaction chambers.

Easy to Operate and Intelligent

The NanoGenizer features a highly modular and integrated control design, making it extremely simple to install and operate. Operators can perform routine operations by clicking the three buttons on the touch screen: "pressure rate," "start," and "stop." Customers find the equipment easy to operate as

they only need to set a desired pressure on the screen and click to start or stop. There is no need for forceful valve adjustment or sample wastage to adjust the pressure. To process particularly small volumes, the setup interface allows users to set the sample volume processed per stroke, the stroke cycle times, and the automatic stop time. Compared to other high-pressure equipment, the operation of the NanoGenizer is elegant and efficient.

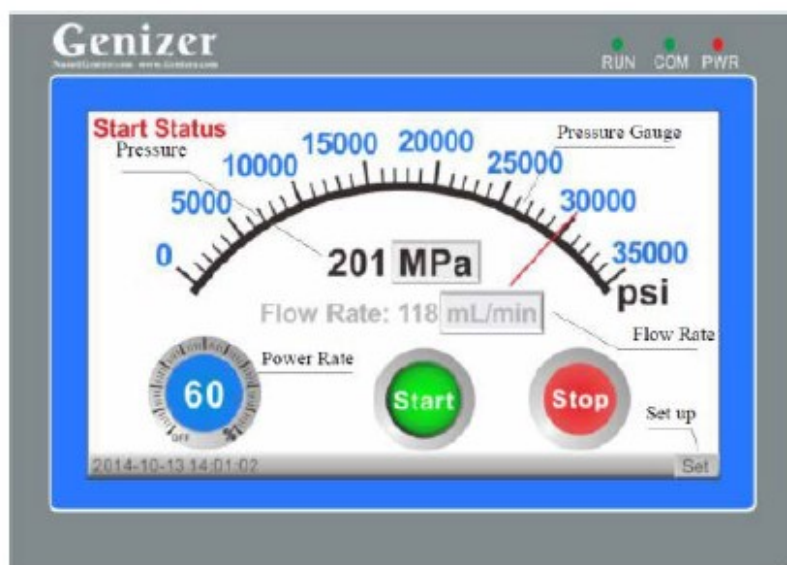


Figure 10. NanoGenizer Operation Interface

Small Minimum Sample

The highly modular design of the NanoGenizer enables simple installation and maintenance. It has a dead volume of no more than 1 mL, significantly lower than the dead volume of other high-pressure homogenizers, typically exceeding 10 mL. Consequently, when processing a 10 mL sample in traditional homogenizers, obtaining product from the outlet becomes nearly impossible. By autonomously setting the volume, the NanoGenizer's modular pipeline design allows for a minimum single processing volume of 5 mL, making it the ideal equipment for preparing and developing rare and costly samples. The NanoGenizer also offers a continuous flow rate of 7 L/h, suitable for conventional small batches.

Software and Hardware Options

Temperature Control: Jacketed interaction Chamber; jacketed inlet cylinder;

3D heat exchanger

Suspension Preparation: Hollow magnetic stirrer

Corrosion Resistance: Titanium cylinder option

Precision Sampling: Precision sampling as accurate as 0.1 mL (e.g., 10.0mL, 10.1mL, and 10.2mL sampling are all possible)

Ports: Data log, USB port, and multi-sensor ports for temperature and pressure

Scientific researchers who have utilized the [NanoGenizer](#) have been impressed by its high processing efficiency, user-friendly operation, and intelligent control. It has emerged as one of the most selected homogenizers for nanomaterials globally.



Figure 11. Applications of NanoGenizer for nanomaterials